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Inter-organizational learning in drifting environments: Experiences from a multi-firm software development project

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Abstract

This paper examines conditions under which organizations can acquire and profitably utilise knowledge generated in joint product development ventures. Past research states that such learning depends on relationships between knowledge accumulation at the level of joint venture and the evolution of knowledge structures in the wider organizational environment. An important argument of this paper is that such relationships might drift abruptly due to unforeseen events taking place during project operation, creating new challenges and opportunities for learning. Drawing upon previous research on project-based learning, the paper proposes a model of interorganizational learning aimed to help managers and researchers visualising links between drift and learning in distributed project contexts. The paper illustrates and assesses the empirical relevance of the analytical framework through a case study of a multi-firm product development project in the European software industry.

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Project-based learning (PBL hereafter) is one of the main ways in which firms interact with and are changed by their environment but experience shows that the full potential for this kind of learning is seldom released (Brady and Davies 2004).

Addressing this challenge, previous research has explored specific organizational conditions in which PBL might be successfully achieved, arguing that such conditions change gradually in step with ongoing learning processes in the wider organizational environment (Prencipe and Tell 2001; Scarbrough et al. 2004a, 2004b; Brady and Davies 2004). Seeking to extend this research, the present paper directs attention towards the ways in which more sudden and unforeseen changes within project group and the organizational environments affect PBL. Drawing upon Kreiner (1994), the paper refers to such changes as environment drift. A project environment is said to drift "when it somehow diverges from the projected course that formed the premise for the design of the project. (Kreiner 1994: 341). This may happen, for instance, if customers change their preferences, competitors change their strategies or corporate management changes its commitments. The objective of the paper is to examine the impact of drift upon learning within the context of distributed product development projects.

The research was organised on the basis of a deductive strategy, starting with a review of existing literature about environment drift and PBL, as well as related theories about personnel turnover and the diffusion of innovations. Out of this review, I deduced a new analytical framework – the project learning space – which integrates three dimensions along which the organizational implications of drift might be assessed; *reinvention capacity*, *compatibility* and *participative continuity*. This framework – which forms the main contribution of the paper – is specifically designed to visualise the links between environment drift and learning within distributed project settings. The literature review and the analytical framework are presented in the third and fourth sections of the paper.

In the latter stages of the research, I used the project learning space to frame and analyse findings from a case study of learning processes within the context of a multi-firm software development project. This analysis and a concluding discussion are offered in sections four and five. Before I get to these parts, however, it is necessary to explain the concepts *distributed product development project*, *project environment, project based learning and environment drift* - and clarify how they are linked together.

Distributed Projects, Project-Based Learning and Environment Drift

While projects are often defined as task-oriented temporary organizations (Grahber 2004), distributed product development projects can be distinguished on the basis that they combine personnel and resources from two or more independent organizations with the explicit aim of developing and implementing a new product. I refer to such organizations in the following as *project partner organizations*. The concept ‘project environment’ is an inclusive one with many associated levels of analysis (Engwall 2003), but in order to keep the complexities of project environments manageable, I restrict the definition here to encompass only the network of parent organizations from which the project extracts personnel and resources.

Drawing on Scarbrough et al. (2004a: 1580) I refer to PBL as ‘the creation and acquisition of knowledge within projects and the subsequent transfer of such knowledge to other projects or the organization(s) from which the project draws resources and personnel’. Drawing upon previous research on this theme, I further categorise PBL according to whether it is of an *explorative* or *exploitative* variety (Keegan and Turner 2001). Exploitative learning refers to the routine behaviour involved in refining an organization’s current capabilities and improving existing technologies, routines and skills. Explorative learning involves searching and experimenting with new combinations of perspectives and knowledge that, if successful, alters or replaces organizations’ existing technologies, routines and skills (March 1991).

The concept ‘environment drift’, which was coined by Kreiner (1994) in an analysis of the project manager role, offers a useful tool for analysing linkages between distributed projects and project environments. According to Kreiner, environment drift alludes to a situation in which the project’s surroundings diverge from the course projected by the project members. The alternative to drift is not stagnation, but rather a situation in which a project’s context develops in a way that is consistent with the project members’ expectations. To mark out more clearly what qualifies as environment drift, Kreiner describes three causes of this process; *tacit knowledge*, *systemic complexity* and *experiential equivocality.*

The relevance of tacit knowledge for environment drift emerges from the fact that, in the project planning phase, stakeholders in the project environment might not be able to express clearly (or even be consciously aware of) matters that in fact matters a lot to them. But as their tacit needs and requirements become more explicit as a result of new experiences, their judgment of the project activities might change accordingly (Kreiner 1994: 339). Systemic complexity refers to the fact that unforeseen events external to the project may change the foundation on which the project and the environment originally negotiated their relationship (Kreiner 1994: 339-340). The launch of a competing project might for instance lead to a situation in which managers lose their original commitment to the project, with serious consequences for the allocation of resources and attention to PBL. The impact of tacit knowledge and systemic complexity on PBL is particularly relevant in distributed product development projects where the allocation of resources for project-based learning depends on the judgment of a potentially large number of dispersed managers and resource controllers.

Finally, experiential equivocality refers to the fact that project insiders and outsiders may interpret the same events in different ways and – on the basis of these interpretations - construct divergent images of the project and the environment. As Kreiner (1994, p. 339) puts it "[t]he project reads the environment not as it is, but as it is modelled by the members of the project. Thus, the project responds to its own image of the environment … while the environment enacts different social constructions and therefore responds in unintelligible and surprising ways towards the project". This latter point is specifically relevant for distributed projects, which integrate several independent organizations and where the co-presence of multiple organizationally derived loyalties and interpretive schemes is commonplace (Blomquist and Packendorff 1998). The confrontation of conflicting interpretations and perspectives might have positive effects in the sense that it induces creative tension and explorative forms of learning (Noteboom 1999). But the downside is that the same tension might stifle collaboration and communication among the project members – thereby restricting the volume of learning experiences that might be extracted from the project (Van de Ven et al. 1999). This is in line with previous research on project management risk which highlights the high level of uncertainty associated with targeted project outcomes (Ekinsmyth 2002).

It is important to note here that the significance of environment drift for learning processes is not unique to distributed projects. The same effects might occur in other kinds of projects – such as those taking place across units within large multi-divisional firms. However, as the above review suggest, distributed projects appear to be a particularly fruitful empirical context in which to analyse the role of environment drift upon PBL. In order to theorize further the relationship between drift and learning within the specific context of distributed projects - and mark out the particular dimensions along which environment drift might be identified - it is necessary to review previous research on PBL.

Literature Review

In the course of the last decade a considerable body of theoretical and empirical research has been conducted on PBL. This research might be roughly categorised into three generations with overlapping boundaries. Contributors to the first are united by a focus on constraints to PBL, conducting their analyses of learning as part of broader themes such as project-based organising (DeFillippi and Arthur 1998, Lundin and Midler 1998, Ekstedt et al. 1999) complex products and systems (Gann and Salter 2000) and intra-firm knowledge diffusion (Hansen 1999). According to this research, an imperative constraint to PBL is the high rate of personnel turnover that characterises many projects and the fact that project groups are often short-lived and typically disintegrate after project completion. This lack of continuity makes it difficult to retain and re-use collective lessons learned (Eskeröd 1998). Moreover, the fact that projects are purposely organized outside firms' departmental structures and formal knowledge-retention mechanisms makes it more challenging to systematically capture and store learning experiences (Hobday 2000).

Contributors to the second generation are united by a more explicit focus on project-based learning, directing specific attention to practical strategies organizations can adopt to improve their PBL performance (Arthur et al. 2001, Keegan and Turner 2001, Prencipe and Tell 2001, Newell et al. 2006). For instance Ayas and Zeniuk (2001) advise firms to develop stable communities of reflective practitioners that cross project boundaries, thereby promoting the continuous diffusion of experiences within and across project groups. A related point is raised by Arthur et al (2001), who propose that an important success factor for project-based learning is the existence of an explicit organizational learning agenda which is supported by top management.

Finally, contributors to the third generation have extended the analysis from an emphasis on learning processes within and across projects, to encompass stocks of flows of knowledge in the wider organizational environments (Engwall 2003, Brady and Davies 2004, Bresnen et al. 2004ab). For instance, Scarbrough et al. (2004a, 2004b) argue that organizations' capacity to learn might deteriorate as projects progress from initiation to completion. As project-groups become more specialised in terms of integrating knowledge from diverse communities of practice, practice-based learning boundaries between the project-group and the organizational environment tend to build up, constraining attempts to exploit the benefits of project based learning for the wider organization. This research resonates with previous research on the diffusion of innovations, as it addresses the ways in which evolving interfaces between organizations and the environment offers opportunities for the transfer of knowledge and learning (Drazin and Schoonhoven 1996).

While the above research demonstrates how the steady accrual of knowledge within project groups and organizational environments creates both impediments and opportunities for learning, few studies have so far addressed the ways in which more abrupt *environment drift* affect learning processes (Blomquist and Packendorff 1998). Moreover, with a few exceptions (Windeler and Sydow 2001), there is little research of PBL within the context of distributed projects (Sydow et al. 2004). As I pointed out in section two, a focus on environment drift in research on learning in distributed projects is justified on the grounds that this process might inflict serious consequences on allocation of attention and resources to project-learning practices. This focus is also justified on the basis that environment drift might directly affect the collaborative dynamics within distributed project groups, and thereby the volume and variety of learning experiences that might be extracted from such these. Addressing this gap in the literature, and taking past research on project-based learning as a starting point, the following section constructs a new analytical model through which the learning-related consequences of environment drift might be more clearly visualised and assessed.

Towards the project-learning space

Past research suggests that the fluid participation of project personnel and evolving interfaces between project groups and organizational environments are two important dimensions affecting project-based learning. In order to theorize further these relationships, it is useful to inquire into existing theories about personnel turnover (Carley 1996) and the diffusion of innovations (Rogers 2003).

During the course of the last decades a considerable amount of research has been conducted on the diffusion of innovations (Rogers and Kincaide 1981, Robertson et al. 1996, Rogers

2003). This research is relevant in examinations of project-based learning in distributed environments since, as Greve (2005: 1026) has stated, it ‘contains frameworks for integrating theory of how the environment offers learning opportunities and how organizations exploit those opportunities’. The existing literature on the diffusion of innovation is too extensive to be adequately summarized here, but in the present analysis of drift and learning in the context of distributed product development projects, it is useful to direct attention to two dimensions that Rogers (2003) highlight as particularly important for the diffusion of knowledge; *reinvention capacity* and *compatibility*.

Reinvention capacity

Organizations aspiring to exploit externally developed knowledge to promote product development typically require some internal reinvention capacity (Von Hippel 2006). Following Rogers (2003: 183), I define reinvention capacity as organizations’ ability to modify and adapt externally developed technologies to change and augment existing technologies. To integrate certain classes of complex and sophisticated technological knowledge into the organization’s product development activities, there is often a need for specific laboratory equipment as well as existing internal staff of technologists who possess deep knowledge about their organization’s distinctive technologies, products and processes. Thus organizations with ample reinvention capacity are likely to be better prepared for to exploit project knowledge in their internal product development, than organizations lacking such capacity. Here, it is important to note that while it might take considerable time and resources to build reinvention capacity, a major organizational event such as a corporate merger or an acquisition might carry with it a rapid increase or reduction.

Compatibility

According to Rogers (2003: 240), compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. While Rogers’ primary unit of analysis is the individual adopter, the level of analysis in the present paper is the organization as a learning entity. This means that, instead of focusing on the distinct characteristics of interacting individuals as the measure of compatibility, I direct attention here to the distinct characteristics of the firms that collaborate in organising distributed projects, and their specific knowledge bases.

Compatibility can accelerate some forms of project based learning, while impeding others. For instance low compatibility might induce passive and active resistance to learning, manifested in negative attitudes towards the new knowledge and scepticism towards new jobs (Henderson and Clark 1990). When compatibility is high, by contrast, organizations are likely to experience less difficulty in internalising and exploiting project knowledge. Under these circumstances, fewer technical integration problems are likely to arise and employees are inclined to have more friendly attitudes towards the learning process. It is important to keep in mind that there is an inverse relationship between compatibility and novelty - if compatibility is very high and the project knowledge is very similar to the organization's existing knowledge the scope for novelty and explorative learning will be correspondingly low, and vice versa (Noteboom 1999). The relationship between compatibility and learning is specifically relevant in distributed product development projects, in which emerging inconsistencies between organizational cultures, working procedures, skills-bases and technologies might block learning initiatives, as well as facilitating unpremeditated explorative learning. The question of how compatibility impacts on learning leads us next to a discussion of the communication interfaces connecting the project group with the organizational environment. Here, it is relevant to look into existing theories about personnel turnover and learning.

Past research on personnel turnover suggests that the rate by which people enter and leave organizations have important implications important implications for those organizations' ability to learn and on their ultimate performance (Carley 1996). When people leave organizations in which there are no effective means of sharing experiences among employees, lessons learned are lost and knowledge disappears (Carroll 1984).

Participative continuity

The links between personnel turnover and learning are specifically relevant in the context of distributed projects because these typically involve fluid membership and significant difficulties with reconvening project groups after project termination (Van de Ven et al. 1999). To analyse these links, I introduce a new concept – *participative continuity* – a category of personnel turnover which relates specifically to distributed projects and measures the rate by which each partner organization puts in and withdraws employees from the project group.

Low participative continuity facilitates wide dispersion of project knowledge in the relevant partner's environment. Here, a relatively large number of the partner's employees participate in the project group for short periods each and diffuse their project experiences broadly as they are transferred to other organizational tasks and functions. Their project knowledge and experiences are likely to be relatively superficial but, if combined with dissimilar and complementary knowledge, might instigate novel ideas and explorative forms of learning. By contrast, a high level of participative continuity facilitates a much more concentrated transmission of project knowledge (Coombs et al. 2003). In this case, a comparatively smaller group of employees participate for longer periods of time. Because of their long-term participation, these employees might search out relevant internal communities, to introduce and build credibility for the project results in these and to facilitate the kind of continuous communication and mutual adaptation necessary for exploitative forms of learning (Hansen 1999). Participative continuity might fluctuate rapidly as a result of changes in human resource allocation strategies or an urgent need for specialised personnel elsewhere in the organization (Esköröd 1998).

The Project Learning Space

The reviewed literature about environment drift and PBL proposes that organizations might achieve both explorative and exploitative learning from participating in distributed product development projects, that learning outcomes depend on emerging relationships between the project and the organizational context, and that unforeseen changes taking place during project operation might abruptly transform these relationships. Drawing upon related theories about diffusion of innovation and personnel turnover, I develop a three-dimensional analytical framework - *the project learning space* – to explore these propositions further (see figure 1).

Here, dimension A gauges the strength of the relevant partner organization's reinvention capacity. By high reinvention capacity, I am referring to a large R&D budget in both absolute and relative terms. Dimension B measures the level of compatibility between knowledge developed in the project and the partner's existing knowledge base. By high compatibility, I am referring refers to a situation in which the project is perceived as consistent with the partner organization's existing operating practices, technologies and needs. Finally, dimension C measures the relevant partner's participative continuity, meaning the average amount of time each of the organization's project members stays in the project group before being transferred to other projects or tasks. The level of analysis along all dimensions, (and the framework as a whole) is the partner organization. While the three dimensions are related, they are not conflated. For instance, as Henderson and Clark (1990) have demonstrated, firms with considerable reinvention capacity might experience serious difficulties in internalising external knowledge because compatibility is low and communication interfaces with the external environment are weak.

Figure 1 about here

I have plotted eight locations in the framework, each posing different opportunities for project based learning. For instance, partners approaching location five might use the project to upgrade their employees' technical skills level and acquire new project management routines. The high participative continuity and low compatibility ensures that a relatively large number of employees become acquainted with technologies and project practices with which they have little previous experience. As these new experiences are diffused across the organizational environment, they might instigate novel ideas and explorative learning. Yet, the lack of internal reinvention capacity makes it difficult to exploit the project technologies directly in product development. By contrast, partners that are located at the opposite end of the frame in the vicinity of position eight are well prepared for exploiting the project results in the improvement of existing products. High compatibility and high participative continuity promote flows of knowledge from the project to relevant internal technical communities, while strong reinvention capacity allows for efficient assimilation and recombination of these. However, firms that are located in this latter position stand few chances of explorative learning; high compatibility means that the project results are likely to be relatively similar to the partner's existing knowledge which, in turn, suggests that there is a low potential for novel knowledge combinations.

Like I emphasised out above, project partners might drift across the space during the operation of a product development project. For instance, an instance of systemic complexity, such as a merger or an acquisition, might carry with it an urgent need for qualified technical personnel in other parts of the organization thereby reducing participative continuity. Such unforeseen changes can also lead to abrupt changes in compatibility levels and reinvention capacity. In the following, I illustrate and assess the empirical relevance of the project learning space by comparing and contrasting it to learning experiences from a distributed product development project in the European software industry.

Case Study: A Distributed Software Development Project

This section presents the LinCo project, a joint venture by three Norwegian, one German and one Greek organization to develop a new software system. LinCo is a fictitious name and for reasons of confidentiality, I do not disclose the real names of the project's partner organizations but refer to these in the following as *Alpha, Beta, Charlie, Delta* and *Echo*. The case study was part of a larger investigation involving two more distributed organizations from the telecommunication industry. This investigation took place between 2001 and 2003 and the objective was to understand innovation collaboration and learning processes within distributed contexts.

Methods

Although there is arguably no such thing as pure inductive or deductive strategies in social research (Ragin 1987), the investigation documented in the present paper was conducted through a mainly deductive strategy and proceeded through two phases. In the first phase I conducted a preliminary review of theories about project- environment drift and project based learning, with the objective of identifying mechanisms linking environment drift and learning within distributed project contexts. Taking the reviewed theories as a starting point, I set out to frame and analyse the LinCo case, which I had already carried out as part of a larger investigation. In this first iteration, I found that the limited set of theories and concepts that I had reviewed were too abstract and broadly defined to account for the complex interactions that took place between environment drift and learning in LinCo.

In the second phase, I returned to the research literature about project-based learning and conducted a broader review, including related research on personnel turnover and the diffusion of innovations. On the basis of this expanded literature review I inferred the present version of the project learning space, comprising the variables reinvention capacity, compatibility and participative continuity. Finally, I returned to the LinCo case and conducted a second iteration of analysis concluding that the new version offered a better match and a more appropriate framing of the empirical findings. The main result of this research process was the project-learning space - a theoretically grounded but empirically validated analytic framework to be used in examinations of environment drift and learning in distributed project contexts. This deductive approach is justified on the grounds that there is by now a considerable amount of explorative and inductively-oriented research on project-based learning. It is appropriate to continue the theory building process by combining existing concepts in new ways and to assess the empirical relevance of these frameworks against relevant case studies (Bitekine 2008).

Interviews and analysis

The primary source of data collection was semi-structured interviews Such interviews are conducted on the basis of a pre-developed interview guide, but new questions can be brought up during the interview as a result of what the interviewee says. I contacted the project manager and presented my research project in December 2000. After this meeting, the manager helped me get in touch with the rest of the project members, taking the role as my gatekeeper to the partner organizations. In total I conducted 28 interviews with a total of 19 respondents. This group includes about 60 % of the individuals who participated directly in the project group, as well as external agents such as top managers and consultants. Most of the interviews were taped, and transcribed verbatim. All interview transcripts were mailed to the respondents for comments shortly after the interview, and in many instances the transcripts were returned with rich comments and suggestions.

I conducted the data-analysis through an intra-case comparative strategy (Ragin1987), meaning that I treated the five partner firms as separate and independent cases for the purpose of marking out contrasts between their learning experiences and how they were affected by environment drift. In the analysis, I operationalized instances of environment drift as ‘unforeseen and significant changes along the dimensions reinvention capacity, compatibility and participative continuity - caused by the surfacing of previously tacit knowledge, the occurrence of systemic complexity and the emergence of experiential equivocality (Kreiner 1994). Before turning to the partner organizations’ learning experiences, I give a brief description of the project and how it unfolded from the planning phase until completion.

The LinCo Project

The project collaboration lasted for five years, beginning with the establishment of a project consortium in August 1998 and ending with project completion in July 2003. Its aim was to implement the new software system in operative units of the partner organizations during project operation and to launch it in the European software market after project-termination. The project was coordinated by a lead partner – Alpha – and the contractual relations between the partners stated shared ownership of jointly developed technology, while safeguarding individual ownership of all previously developed technologies.

The project consortium was heterogeneous in terms of size and areas of business (see table 1). Alpha is a diversified multinational corporation providing industrial risk management products and services. Charlie and Delta are among Europe's largest R&D organisations. The remaining two partners are SMEs that focus more narrowly on specific software products and ICT consultancy. The consortium sought to develop a new software product for extended enterprise planning and execution. Extended enterprises (EE) are organizations that span geographical and organizational boundaries, while EE-software systems enable employees to create on their computer screens graphical representations of structure, resources and responsibilities in such organizations. In simple terms, LinCo's system consists of two main constituent parts: 1) Four stand-alone software systems with complementary functionalities. 2) A shared system architecture merging these four systems into a larger system (see figure 2).

Figure 2 about here

The system architecture is a complex structure of interfaces through which the four component software can communicate with one another, comprising mutual data exchange formats and computer languages, and a web-server software allowing users to access the integrated system using a computer connected to the Internet.

The project collaboration proceeded through two distinct phases; a planning phase and an execution phase. In the first phase, which lasted from August 1998 until January 2000, employees from partners Alpha, Beta, Charlie and Delta planned and acquired funding for the project. The main task of the planning phase was to create the system architecture. Doing this was challenging since four partners had their own distinct proprietary software architectures and were eager to secure a high level of consistency between these and the project's architecture. To satisfy the expectations of all partners, the project planners ended up specifying a versatile architecture which could more or less easily be integrated with each partner's existing software systems.

In the ensuing project execution phase, lasting from January 2000 until July 2003, the creation of the system architecture became a contested issue, causing conflict and prolonged negotiations within the project group and carrying with it important implications for learning. This situation, which might be analysed as a consequence of environment drift (Kreiner 1994), emerged for three related reasons: First, the project members' initially shared image of the project's goals and activities proliferated into multiple distinct perspectives and images in the course of project operation. This resonates with Kreiner's (1994) concept experiential equivocality. Second, as the project members' previously tacit needs and assumptions related to the system architecture became more explicit as a result of project experience, several project members started doubting the relevance and usefulness of the original technical plans and specifications. As one project member put it:

The original technical specifications were not concrete enough, they were just too abstract. We did not really see the problems ahead. We would have needed a more fine-grained level of detail to know whether we were able to undertake all of the projects ambitions in practice.

The third reason might be characterised as an occurrence of *systemic complexity* (Kreiner 1994). Six months into the project execution phase Beta was acquired by a medium sized Norwegian software developer. As a result of strategic changes associated with the acquisition, project members from that partner started campaigning for a change in the architecture, suggesting that the project group switch their original web-server software with Beta's proprietary web-server. When this switch was suggested, intense and time-consuming negotiations arose because the suggested change would render the system less compatible with the other partners' software systems.

The negotiations continued with varying intensity for about two years until the group acquiesced and went along with Beta's suggestion. At project completion in July 2003 the project had developed a product prototype instead of the commercial product it originally planned for. According to the project members, the project's failure to reach its original goals was closely linked to the time- and resource consuming negotiations about the system architecture. Also, planned initiatives to diffuse the project's learning experiences and results in the organizational environment were thwarted because of the delays and setbacks. To examine further how environment drift influences learning within distributed project environments, it is necessary to look more closely at the distinct learning experiences of LinCo's five partner organizations.

Alpha's Learning Experiences

Alpha is a large multinational corporation encompassing a sizable R&D division with extensive software development activities. The corporation joined the consortium in order to redevelop and improve a project simulation software system it had licensed from an external company. According to this agreement, Alpha was given the source code of the software so that it could be redeveloped and customised to Alpha's international project activities. The project was deemed useful because it could speed-up the redevelopment process adding new functionalities to the simulation software. Consistent with this view, top management signalled an ambitious project learning agenda (Arthur et al. 2001); to facilitate easy exploitation of the project results Alpha set up closely related research on the simulation software inside its R&D division. Moreover, Alpha assigned to the project a group of senior software engineers, who forged a strong communication link between the project group and related activities within the R&D division.

In April 2000, top-management decided for strategic reasons to terminate the software licensing agreement. Since the agreement was not renewed beyond the duration of the project, internal research on the simulation software was discontinued. This change carried with it a reduction of managerial support for the project and a decrease of compatibility between the project activities and Alphas internal activities. Three months later, in June 2000, participative continuity also plummeted as management decided to move the responsibility for the project from the R&D division to the corporation's internal consulting division.

These events affected project-based learning in two ways. First, the disconnection of the project from Alpha's R&D division deprived the project group of important personnel. Several experienced engineers who had played key roles in the project planning phase left the project group and were replaced by internal consultants with much less technical experience, most of who participated for very short periods of time. According to several project members, this significantly slowed down the progress of knowledge creation inside the project, thereby curbing all partners' learning opportunities.

Second, the discontinuation of Alpha's internal research on the simulation software complicated the task of diffusing the project results in the organizational environment. While the original participants had created links between the project and similar research in the R&D division, the people from the consulting department were more internally mobile and offered instead many weaker contact points with a larger number of divisions, departments and projects. In spite of several attempts to introduce and 'sell' the project's technologies in different parts of the organization, Alpha's employees staunchly abstained because they found the technologies unfamiliar and difficult to use. One manager gave this example:

We tried to test the project's software solution here. I found a project I thought was perfect so I tried to convince the team members to use it, but they told me that their project would be substantially delayed if they used the solution so they turned it down.

Beta's Learning Experiences

Beta is a small Norwegian software developer specialising in enterprise architecture software. When the project consortium was established in 1998 the company was a small subsidiary of a large electronics corporation. Beta's initial motivation for joining the consortium was to access the other partners' software systems and explore opportunities for using these in the improvement of existing products.

Six months into the project execution phase, Beta was acquired by a medium sized Norwegian software company. This change had two important effects. First, it reduced Beta's accessible reinvention capacity - the electronics corporation possessed much larger R&D resources than the acquiring SME. However, according to one manager, this did not seriously restrain project based learning. Beta still possessed sufficient software programming capabilities to internalise and exploit the project results. Besides, the acquisition carried with it increased organizational support for the project, inducing managers to formulate a clearer and more ambitious learning agenda. One project member described the change in this way:

The company used to be a very small part of a large multinational corporation. Now it is a comparatively bigger part of a Norwegian SME and the project has become much more important.

Second, the acquisition led to a change in compatibility. At the time of the purchase, the acquiring SME was working on refining a prototype EE system which was similar to the LinCo project's system. The most important difference between the two systems was that they incorporated different types of web-server software, making them difficult to integrate. Thus, as a result of the acquisition, Beta faced the dilemma of having to develop two fairly similar but incompatible software products competing for the same resources. In dealing with this problem, Beta's project members successfully campaigned for a decision to discard the web-server specified in the project plans and adopt Beta's server instead. This change raised compatibility significantly, enabling Beta to use LinCo as a test bed for its own prototype EE system.

To facilitate transfer of learning between the project and internal software development, Beta kept a stable group of senior software programmers in the project group. These kept in close contact with internal programmers who reinvented and customised the project's software, using this directly in the creation of a new commercial project. According to a Beta manager, the project caused significant exploitative learning in Beta, contributing to a new generation of software systems.

Charlie's Learning Experiences

Charlie is a large Norwegian contract R&D organization with ample reinvention capacity, covering a wide range of technologies. The organization participated in the project through one of its software development departments, supplying a proprietary workflow management tool to the project. The purpose was to integrate this software with the other partners' systems, thereby extending Charlie's portfolio of interlinked software technologies. The project initially enjoyed strong support from managers and employees, but the decision to adopt Beta's web server reduced the level of compatibility between the project and Charlie. While the technical standards underlying the old web-server software were perceived as compatible with the standards underpinning Charlie's software systems, those embedded in the new web server were not. In spite of Charlie's strong reinvention capacity and a high level of participative continuity, this change caused severe technology integration difficulties. One employee described the problem in the following way:

The project's different component systems have very different requirements to the web-server. Our system works on one object at a time and needs the ability to store these continuously and rapidly in the database. Their (Beta's) system can take up a model with perhaps a 1000 objects at a time. This means that the user works on the model for a couple of hours before the model has to be stored. When we adopted the new web server, which was specifically designed to support their system, our system became very slow. We banged our head against the wall because we had to write and read in these large files every time we made a small change.

Charlie's project members tried to alleviate this problem by adjusting the standards underlying some of their existing software systems to match those of LinCo, but a strategic decision by top management blocked this attempt. Facing the burst of the dot-com bubble and declining markets for unique software projects in 2001, top management decided to streamline internal software technologies according to a specific set of standards that differed from those underlying the project's new web server. Thus, as was the case in Alpha, a strategic change by top management served to reduce the perceived relevance and usefulness of the project. As a result, the software integration problems perpetuated and learning effects were modest. As one manager put it:

We decided not to spend our own resources on developing the project results further, but we are happy if the other partner organizations exploit our ideas. We see that if they invest in this technology it may generate new projects for us down the road.

Delta's Learning Experiences

Delta is a large German R&D organization with ample software development activities. This organization joined the project to redevelop a proprietary software for synchronous computer-mediated collaboration. The purpose was to test this software in different user-environments, and to link up with partners who could add new functionalities and convert it into a commercial product. Like in Alpha, the project group's decision to adopt Beta's web server led to a reduction in compatibility, making the employees more reluctant to internalising and exploiting the project results. Resembling the difficulties experienced by Charlie, Delta's problem was that to successfully internalise the project's software system it had to make costly adjustments to its existing software systems. As one employee put it:

Since this new solution is written in their (Beta's) environment, some parts of our software tools have to be changed according to this environment. This requires recoding using different software. We are not really benefiting from this. Instead, recoding our tools so that they fit their environment becomes overhead costs.

In spite of these difficulties, the project carried with it considerable explorative learning effects for Delta. Towards the end of the project, Delta established a spin-off company in which the project results were reinvented, combined with other software technologies and converted into a new and commercially successful product. The spin-off contributed to solving the compatibility problem since the new company was not equally constrained by established software standards and needs, and thus more receptive to the project's software. After project completion, the spin-off stayed in close collaboration with Delta permitting the latter to reap further learning effects. One manager described this learning process in the following way:

The project wasn't directly valuable to us in terms of ongoing internal development, but much of the thinking underlying the project was essentially new to us. And it has had an impact on many of the developments that we are doing now.

Echo's learning experiences

Echo is a consortium of seven small Greek, Bulgarian, Belgian and German IT consultancies, headquartred in Patras, Greece. The organization did not take part in the project planning phase, but was admitted as a partner shortly before project initiation in late 1999. Echo joined the project to enter a new market of EU-Framework projects as a provider of project administration and technology testing services.

In contrast to the other partners, Echo did not have internal software development and reinvention capabilities, and thus had no means of exploiting the technical project results directly in new product development. Moreover, Echo's employees had no previous experience with LinCo's software systems or with participating in international software development projects. There was thus initially a low degree of compatibility between the project activities and Echos existing skills and project routines. In addition, there was a low degree of participative continuity - most participants from Echo joined the project for a few months only before they were reassigned to a different project or to other internal activities. Echo consciously used the project to achieve explorative learning, acquiring what Brady and Davies (2004) refer to as initial 'project capabilities'. By moving into a new project market, and by allowing a large proportion of its employee to experiment with new and unfamiliar project practices, Echo prepared itself for taking more advanced roles in similar future projects. According to one manager, these relatively superficial, but broadly diffused skills helped the organization detect, bid for and undertake similar projects subsequent to project completion. Indeed, to Echo the main value of the project lay exactly in the low degree of compatibility. As one employee put it:

Since Greece is generally a few years behind the technologically most advanced countries of Europe, our organization seeks to co-operate with advanced companies outside Greece to be able to source this knowledge. It is one of the first Greece-based companies to participate in such a large and complex European research project. Exploring new and unfamiliar knowledge is an important objective for us.

5. Comparison: Project Based Learning in Distributed and Drifting Environments

The case study findings resonate with the main traits of the project learning space, demonstrating that the partners' different positions along the dimensions of reinvention capacity, compatibility and participative continuity prepared the ground for different kinds of learning outcomes. While LinCo induced exploitative forms of learning in Beta, the project carried with it explorative learning in Echo and in Delta (through a spin-off company). Alpha and Charlie, on the other hand, ended up with more limited learning effects. The findings also chime in with the proposition that environment drift – caused by the explication of tacit knowledge, systemic complexity and experiential equivocality - might induce changes along these dimensions during project operation. To offer a more comprehensive comparison of the partners' learning experiences, it is helpful to take a second look at the project-learning space.

Figure 3 about here

All project partners except Echo moved across the project learning space during the project's lifetime and, in line with the framework's propositions, these changes influenced learning activities and learning outcomes. During the planning phase Alpha, Beta, Charlie and Delta matched the same position close to corner eight in the model, aspiring to exploit the project results directly to improve existing technologies and products. Being large product development organizations, or subsidiaries of such organizations, they possessed R&D resources necessary to reinvent and internalise the project's software technologies. There was also a relatively high level of compatibility between the project and internal product development activities, and each of these partners maintained a high level of participative continuity during this phase. In the subsequent project execution period a number events changed the conditions for learning, causing Alpha, Beta, Charlie and Delta to move in different directions.

First, the project's decision to switch web-server software changed compatibility levels. In Beta, this led to an increase in compatibility, making the organization more receptive to the project results. In spite of a reduction in reinvention capacity brought about by the transfer of ownership of Beta from a large corporation to an SME, this partner managed to exploit the project results directly in the development of a new product. At the same time, the change of web server reduced compatibility with Charlie and Delta, making it more difficult for these organizations to utilise the project results directly in product development. While Charlie experienced severe integration difficulties and ended up with modest learning effects, Delta tackled the compatibility problem by establishing a spin-off company which was more receptive to the project technologies.

Second, Alpha's top management's decision to terminate internal R&D on the simulation software led to a reduction in management support and lowered the level of compatibility between the project and Alpha's internal software development activities. The transfer of project-responsibility from the R&D division to the internal consulting department carried with it a reduction in participative continuity. These combined changes made it much harder to diffuse and exploit the project results in the internal environment, leaving this partner with a modest learning outcome.

Concluding Discussion

I have examined how project environment drift affects learning in the context of distributed product development projects. In this examination, I deduced from existing theory a new analytical framework (the project learning space) and subsequently used it to frame and analyse a case study of a multi-firm software development project. The project learning space - which constitutes the main contribution of the paper – might be useful to both researchers and project practitioners because it visualises links between environment drift and different kinds of learning within distributed project contexts. As the analysis demonstrated, systemic complexity might carry with it changes along the dimensions of reinvention capacity, compatibility and participative continuity, with direct implications for the transfer of learning from the project to the partner organizations. Moreover, the surfacing of previously tacit knowledge and the emergence of experiential equivocality among project members might turn originally unified and compatible objectives into divergent and competing objectives, with serious implications for the intra-project learning processes. Environment drift can affect PBL in negative ways, obstructing collaboration and thwarting planned learning initiatives, but also in quite positive ways, facilitating unintended learning effects and providing new variations in technologies, skills and routines. Before discussing the implications of these findings, it is important to note some important limitations associated with the analysis.

Limitations

Limitations associated with a single case strategy are well known. Since single members poorly represent whole populations, one case study is often seen to be a weak basis for generalization. However, the LinCo case is valuable in the sense that it is used in the development of new theories and concepts, which might be regarded as a form generalization in the sense that logically constructed concepts and theories can have relevance outside the context in which they were developed (Ragin 1994). Second, the analysis is limited in the sense that it neglects many dimensions that might potentially account for learning processes in distributed contexts, including dynamics of power (Van de Ven et al. 1999), the strength of ties (Hansen 1999) and social capital (Bresnen et al. 2004b). I chose to direct specific attention to reinvention capacity, compatibility and participative continuity, following reasoning that these are particularly relevant in analyses of drift and learning within distributed project contexts. Notwithstanding these limitations, the paper has several implications for existing research on these topics, suggesting ways in which this research could be complemented and revised.

Implications

The analysis is relevant for researchers interested in how environment drift affects project-based organising. In his discussion of environment drift, Kreiner (1994) highlights the central role of experiential equivocality, referring to a situation in which project insiders and outsiders construct divergent images of the project and the environment and therefore act in contradictory ways. The study of LinCo resonates with this argument, but adds some additional perspectives which might be useful in future studies of this topic. While Kreiner – for analytical purposes - models the project group as a coherent entity that constructs one singular image of the environment, the present paper directs attention to the fact that single project groups are often strongly heterogeneous and might develop multiple competing images of their own activities and of the environment (Van de Ven et al. 1999). As the analysis demonstrated, such intra-project experiential equivocality might have important implications for project based learning, both in the sense that it can slow down the generation of learning within the project group, and in the sense that it can unleash creative tension and unexpected learning effects (Noteboom 1999).

The analysis also has implications for research on project-based learning. Several contributors to this research propose that the fluid participation of project personnel, constitute an important constraint to project based learning, suggesting that a solution might be found in the formation of more stable communities for project reflection which are supported by explicit and durable organizational learning agendas (Keegan and Turner 2001, Ayas and Zeniuk 2001). As Arthur et al (2001: 112) put it 'company commitments to specific learning trajectories must be more durable than the particular projects enacted within those learning trajectories.' The present analysis concurs with these arguments, but emphasises that the durability of such learning agendas might be highly vulnerable to the impact of environment drift. As the experiences of Alpha and Charlie demonstrate, initially strongly supportive organizational learning agendas might be discarded during project operation due to unforeseen changes in the strategic landscape. It thus might be more effective to think about organizational learning agendas not as something that is made durable by a managerial decision prior to project launch, but rather as something that is inherently unstable and might shift abruptly during project operation. As I have pointed out above, such unpredictability can be considered a benefit since abrupt changes in corporate learning agendas might facilitate a greater degree of exploration and variation in corporate learning processes. This point resonates with the argument of Arthur et al. (2001: 104) that 'not all learning can occur in response to pre-ordained objective, since slavish commitment to any objectives would undermine new learning opportunities'.

A more recent set of studies of project-based learning emphasise that the gradual accumulation of knowledge within project groups and their organizational environment creates both obstacles and opportunities for learning (Scarbrough et al. 2004a, 2004b, Brady and Davies 2004). The present paper extends this research, demonstrating how more abrupt changes in the organizational environment also affect project-based learning. While the steady accumulation of project capabilities might facilitate exploitative learning over time (Brady and Davies 2004), the learning process might deteriorate abruptly if the organizational department in which the relevant project capabilities reside is sold off or otherwise disconnected from the project group. Moreover, while some constraints upon project-based learning arise from the ongoing build-up and embedding of knowledge structures within the organizational context (Bresnen et al. 2004b), a major organizational change such as the establishment of a spin off company might reduce some of these constraints. This suggests that future investigations of project based learning might benefit from taking into account the interplay between the gradual build up of project capabilities and more sudden changes associated with environment drift.

For project managers the project learning space in particular - might serve as a sensitizing tool providing a better overview of the complex and rapidly changing conditions for learning in distributed product development projects. By synthesising several different perspectives on the learning processes in such projects, and by making these perspectives operational in a strategic assessment framework the project-learning space might assist managers in preparing for and tackling the consequences of environment drift. Although the framework was designed for the analysis of this particular category of projects, the dimensions of learning involved in the present version might be modified or replaced by other dimensions to provide a more suitable tool for examining projects in different organizational settings. Further application in future research is necessary to evaluate its wider usefulness in other circumstances.

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Tables and figures

Figure 1

Figure 1: The project learning space

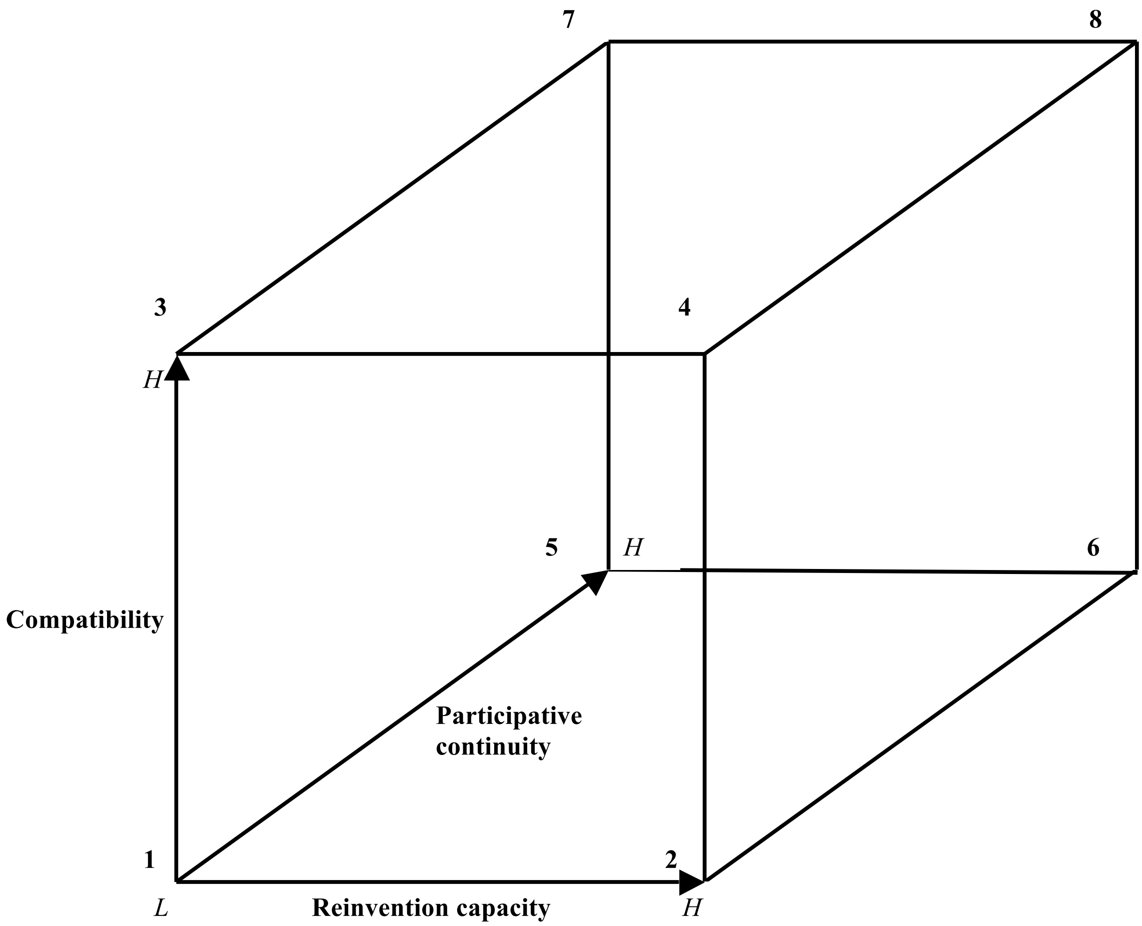

Figure 2

Figure 2: LinCo's software system

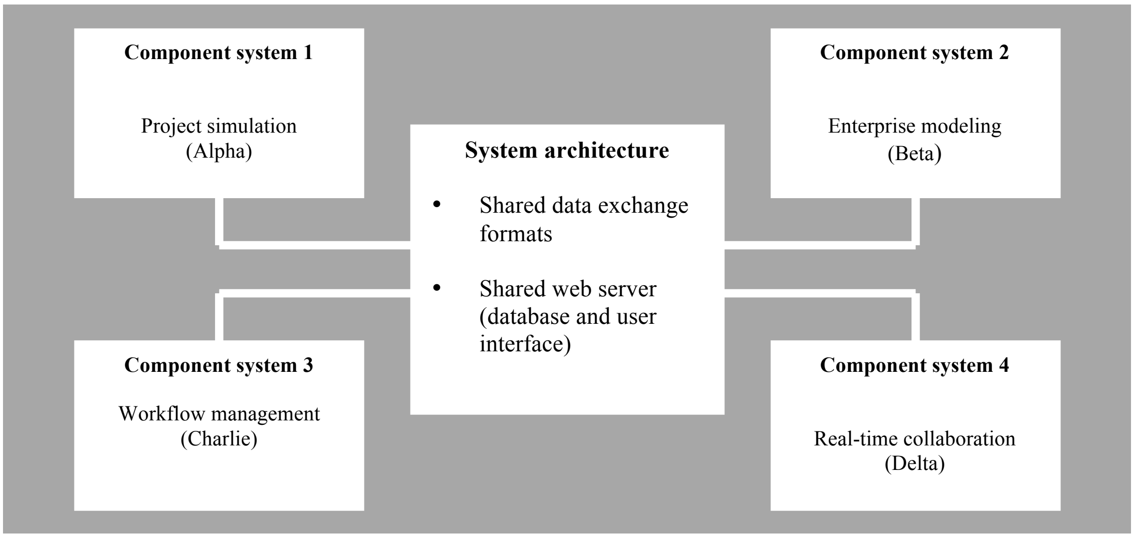

Figure 3

Figure 3: Project based learning in drifting environments